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Appl. No.	:	10/691,890	Confirmation No. 9015
Applicant (s)	:	Urscheler, et al.	
Filed	:	October 16, 2003	
TC/A.U.	:	1762	
Examiner	:	Katherine A. Bareford	
Title	:	METHOD OF PRODUCING A COATED SUBSTRATE	
Docket No.	:	62739C	
Customer No.	:	00109	

I HEREBY CERTIFY THAT THIS CORRESPONDENCE IS BEING DEPOSITED WITH THE UNITED STATES POSTAL SERVICE AS FIRST CLASS MAIL WITH SUFFICIENT POSTAGE IN AN ENVELOPE ADDRESSED TO: ASSISTANT COMMISSIONER FOR PATENTS, WASHINGTON, DC 20231, ON:

October 26, 2006
DATE OF DEPOSIT

Joyce E. Clark
PRINT OR TYPE NAME OF PERSON SIGNING CERTIFICATE

Joyce E. Clark
SIGNATURE OF PERSON SIGNING CERTIFICATE

October 26, 2006
DATE OF SIGNATURE

Assistant Commissioner for Patents
Washington, D.C. 20231

Sir:

DECLARATION UNDER 37 C.F.R. § 1.132

I, Dr. Wolfgang Bauer do hereby declare that:

1) I received a "Dipl.-Ing" (M.Sc.) degree in Chemical and Process Engineering (Field of Specialization, Paper and Pulp Engineering) from the Graz University of Technology in 1987. I received a "Dr.techn." (Ph.D.) degree in Chemical and Process Engineering (Field of Specialization, Paper and Pulp Engineering) from the Graz University of Technology in 1992.

I have worked for 14 years in the field of paper coating, starting with my employment in 1992 at the R&D department of Leykam-Mürztaler AG (later KNP Leykam, now Sappi Fine Paper) in Gratkorn, (Austria). From 1994 to 1997 I was the head of the R&D Basepaper & Coating group. In that function I was responsible for

all R&D activities in the ***Triple Star*** project, which was the internal name for the project of designing and erecting PM11/CM11 (paper machine and coating machine 11) in Gratkorn, which went into operation in October 1997 and was at that time the most productive production unit for coated woodfree paper worldwide making Gratkorn one of the three largest coated woodfree paper mills worldwide. My main responsibilities in the project were the selection of coating processes and methods for the triple-coating (multiple sequential single coating) process and the design of coating formulations.

Shortly after the start-up of the new production unit I became a member of the management team of Gratkorn mill in 1998 with the area of responsibility "Process & Quality Management." In that function I was constantly engaged in the improvement of the mills coating processes and methods and was also involved in various pilot trials of new and improved coating processes and methods, amongst others single layer, slot type curtain coater trials and spray coating trials.

In October 2003, I was appointed Professor for Paper and Pulp Technology at the Graz University of Technology in Austria and appointed as the Head of the Institute for Paper, Pulp and Fiber Technology at the Graz University of Technology. Presently I still hold this position.

I have been a member of the Zellcheming Technical Committee COAT for several years (web: www.zellcheming.com/fachausschuesse), a committee of engineers and scientists from different European paper companies and research institutes that all are involved in the field of paper and board coating. Very recently I have been appointed as committee member of the Pulp and Paper Fundamental Research Society (web: www.ppfrs.org.uk), an independent, charitable organization registered in Great Britain for the promotion of research and education in the pulp and paper industry.

2) I was asked by Mr. Robert Urscheler, one of the named inventors of the above identified patent application, to review the identified patent application, and related papers, and to submit this declaration, and I have done so under the terms of a consulting agreement.

3) I reviewed U.S. Patent Application Publication US 2004/0121080 A1, which is the publication of the present patent application. I also reviewed the following independent claims, which I understand are the currently pending, amended, independent claims of the application:

Claim 1: A method of producing a coated substrate comprising the steps of:
a) forming a composite, multilayer, free flowing curtain, the curtain having a solids content of at least about 45 weight percent and a first component and a second component capable of reacting with each other, and b) contacting the curtain with a continuous web substrate wherein the continuous web substrate has a web velocity of at least about 600 m/min.

Claim 30: A process for producing a coated substrate comprising the steps of:
a) forming a composite, multilayer, free flowing curtain, the curtain having a solids content of at least about 45 weight percent and at least one component capable of reacting with itself or another compound, and b) contacting the curtain with a continuous web substrate, wherein the continuous web substrate has a web velocity of at least about 600 m/min, and wherein at least one component of the curtain begins reacting during the coating process and is essentially completely reacted before the coating process is complete.

Claim 80: A method of producing a coated paper or paperboard comprising the steps of:
a) forming a free flowing, multilayer curtain, the curtain having a first component and a second component capable of reacting with each other, wherein the curtain further comprises polyethylene oxide in the interface layer, and
b) contacting the curtain with a continuous web substrate wherein the continuous web substrate has a web velocity of at least about 1,000 m/min.;
wherein the curtain has a solids content of at least about 45 weight percent

4) Based upon my knowledge of the paper coating industry, the subject matter of the claims listed above was not in line with conventional wisdom of one skilled in the art of paper coating, as of the filing date of its parent application, namely October 17, 2002. Specifically, the subject matter of the listed claims goes against conventional understanding in that the claimed combination of substrate velocity and

curtain solids would have been thought to be outside the window of acceptable coating conditions for composite multilayer curtain coating.

In the late 1990's it was conventional wisdom of one skilled in the art of paper coating, that forming a single layer curtain using a slot type curtain coater at substrate velocities >600 m/min and at solid contents > 45% was possible. Significant research and development efforts in improving the coating application window with regards to substrate velocity, coating solids and coating formulations were carried out by coating machinery manufacturers, paper chemical suppliers and coated paper manufacturers alike, but it was conventional wisdom that this work has been directed exclusively at slot type coaters producing single layer curtains.

As of October 17, 2002, conventional wisdom of one skilled in the art of paper coating regarding slide type curtain coaters producing multilayer composite curtains was, that these types of coaters were traditionally applied in photographic applications and in some other specialty paper applications at low speeds and low curtain solids.

It was not appreciated by those skilled in the art of paper coating that the technological developments allowing the application of a single layer curtain produced by a slot type curtain coater (e.g. vacuum deaeration of coating formulations to avoid air bubbles, efficient removal of the air boundary layer at the substrate surface prior the contact point with the curtain) at high substrate velocities and coating solids would allow the formation of a composite multilayer curtain on a slide type curtain coater at similar high substrate velocities and coating solids. This is because many of the problems associated with forming a composite multilayer curtain (e.g. curtain stability at the low thickness/volume of each separate layer at high coating solids and substrate velocities, efficient layer separation and layer continuity at the low thickness/volume of each separate layer at high coating solids and substrate velocities in the free falling curtain and during the elongation at the point of impact to the substrate, adjustment of surface tensions of the various layers having different surface ages to allow the formation of a stable composite multilayer curtain) were not considered to be solved by the solutions applied in the formation of a single layer curtain. Stated another way, the increased complexity of multilayer curtain coating meant that knowing how to coat at >45% solids at >600 m/min. with a single layer

did not, as of October 17, 2002, translate to knowing how to coat at these conditions using a multilayer curtain.

5) I have reviewed U.S. Patent 6,746,718 B2 (hereinafter Yokota). Yokota's patent is directed to multilayer coating, but only at low substrate velocities and at low coating solids.

Yokota tried to overcome a major deficiency of multilayer curtain coating at low solids, namely, the poor layer purity due to water transport phenomena in the direction to the base paper. He did that by increasing the viscosity in the interface between the layers through a "chemical reaction" or by applying an interface layer (either using a separate coating or as part of the multilayer curtain) between the base paper and the coating in order to limit water transport towards the base paper to increase layer purity.

Logically speaking, the most direct way to limit water transport phenomena would have been for Yokota to eliminate water from the coating formulations, i.e. to increase the curtain solids content. One logical explanation for Yokota not to run at higher solids in multilayer curtain coating, and at the necessary higher substrate velocities to keep the deposited coat weights at the same level at a given curtain volumetric flow rate, is that he did not know how to do achieve this. Another possible explanation is that he did not want to, i.e. he preferred to operate at low solids and substrate velocities.

The examples provided by Yokota clearly show that he did not try this most logical solution to increase solids. All his formulations contain large amounts of water, which he tried to inhibit from penetrating towards the base paper instead of not adding the water in the first place. The only logical explanation for this would be that he needed a certain amount of curtain volumetric flow to keep the curtain stable and therefore could not go to higher solids, even at the low coating speeds he ran.

6) I have reviewed U.S. Patent 6,146,690 (hereinafter Kustermann). The Kustermann patent is for a curtain coater device and a suction device to remove air. The main feature of the invention is just another way of the efficient removal of the air boundary layer on the substrate web, which is well known to be one of the preconditions to perform any type of curtain coating successfully, especially at higher

substrate velocities. Kustermann's disclosure regarding coating solids and substrate velocities is of a general nature. However, there is no indication of multilayer curtain coating in Kustermann, and Kustermann's generic teachings on coating solids and substrate velocities taken together still would not permit anyone skilled in the art of paper coating to successfully practice multilayer curtain coating at high substrate velocities and coating solids.

7) I have reviewed U.S. Patent 5,885,659 (hereinafter Takahashi). The Takahashi patent is for a device to cut the curtain at start up and finishing of a coating operation without the formation of excess coating impairing the quality of the produced paper. This device would work for any kind of curtain (slide or slot), since the main feature of the invention is the catch pan design allowing the cutting of the curtain. In his examples, Takahashi demonstrates forming a single layer curtain for a NCR (carbonless paper) paper coating formulation at 33% solids at 1,000 m/min., which was state of the art at the time of filing this patent. The Takahashi catch pan device would be capable of cutting a multilayer curtain formed on slide type coaters, which at the filing date of the Takahashi patent were already in use in photographic applications and in some other specialty paper applications at low speeds and low curtain solids. There is no indication in Takahashi teaching anyone skilled in the art of paper coating, how to form a multilayer curtain at high coating solids and at high substrate velocities.

8) I reviewed the Office Action mailed April 26, 2006. I compared the independent Claims 1, 30 and 80 listed above to Yokota, Kustermann and Takahashi.

9) The content of Yokota, Kustermann and Takahashi, taken together, does not contain information that would allow me, or other persons familiar with the art of paper coating, to practice the subject matter of Claims 1, 30, and 80 as shown above, as Yokota, Kustermann and Takahashi do not indicate how to practice multilayer, reactive, curtain coating using a curtain having a solids content of at least 45 weight percent with a web velocity of at least about 600 m/min.

10) Neither Kustermann nor Takahashi provide enough information to show how one would practice multilayer curtain coating at a web speed of at least 600 m/min. using a curtain having a solids content of at least 45 weight percent.

11) In curtain coating there is a strong interdependence of all involved parameters like curtain flow rate, coating solids and density, coating viscosity, surface tension of the coating, fall height of curtain, substrate velocity and the film thickness deposited on the substrate, which again dependent on coating solids influences the final dry coat weight applied to the substrate.

The window of curtain coating operation is on the one hand limited by curtain stability (low flow limit) and on the other hand by heel formation at the point of impingement on the substrate (maximum flow limit).

A good example to demonstrate these interdependencies is a recent publication by Alleborn et al. 1, who proposed for a slide type curtain coater forming a <u>single</u> layer curtain a set of non-linear equations, that can be solved numerically, for the minimum and maximum wet film thickness deposited on the substrate.

In order to achieve a stable curtain the minimum wet film thickness d_{min} for a given substrate velocity was given to be [1]:

$$\left(\frac{\rho\, g\cos\beta}{3\mu}\right)^{2/3} U^{10/3} d_{\mathrm{min}}^{10/3} + 2g\left(H - H_0\right) U^2 d_{\mathrm{min}}^2 - \frac{4\sigma^2}{\rho^2} = 0$$

ρ density [kg/m³]

β angle of inclination slide type curtain coater

μ dynamic viscosity [Pas]

U substrate velocity [m/s]

H fall height of curtain {m]

$H_0 = 2(4\mu/ \rho\sqrt{g})^{2/3}$ empirical parameter

σ surface tension [N/m]

The maximum wet film thickness d_{max} that could be deposited on the substrate without disturbances in the coating by heel formation was given to be [1]:

$$\left(\frac{\rho g \cos\beta}{3\mu}\right)^{2/3} U^{4/3} d_{\mathrm{max}}^{10/3} + 2g\left(H - H_0\right) d_{\mathrm{max}}^2 - 38{,}06\frac{\mu^2}{\rho^2} = 0$$

[1] N. Alleborn, F. Durst, H. Lienart: Anwendung der Vorhangbeschichtung zur Oberflächenveredelung von Bauelementen aus Beton. Chemie Ingenieur Technik (2005), Vol. 77, Nr. 1-2, p. 84-89

These interdependencies are even more pronounced in the formation of a multilayer curtain, since other effects already described hereinabove in paragraph 4) also have to be considered.

12) It would not be a simple matter to raise the solids content of the process of Yokota, nor did Yokota find that to be desirable or possible, as is demonstrated by the unnecessarily large amounts of water he added to all coatings in the given examples. By recalculating his examples it becomes clear that Yokata always deposited rather high thickness wet films onto the substrate, which can be explained by the curtain stability criteria on the one hand and by the targeted dry coat weights at the rather low solids content of his coatings on the other hand.

13) Increasing the coating speed of the Yokota curtain would have led to too low wet film thicknesses and too low final dry coat weights deposited on the substrate. Increasing the solid content of the Yokota curtain would have led to too low curtain flow rates at the given substrate speed, thus violating the stability criteria of the curtain, i.e. a stable curtain would not have been formed.

14) The undersigned declares further that all statements made herein of his own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issuing thereon.

2006-10-23
Date

DR. WOLFGANG BAUER